UNIVERSITI TEKNOLOGI MARA

SUPERCONDUCTING PROPERTIES OF CALCIUM SUBSTITUTION AT BARIUM SITE OF POROUS YBCO CERAMICS

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. The topic has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

The influence of Ca substitution on the superconductivity at the Ba site of porous $Y(Ba_{1-x}Ca_x)_2Cu_3O_\delta$ (x = 0.00, 0.05, 0.10, 0.20, 0.30, and 0.40) samples were prepared via solid-state reaction method. The morphology and structural identification, elemental composition, critical temperature and critical current were determined by field-emission scanning electron microscopy (FESEM), X-ray diffraction (XRD), energy dispersive X-ray (EDX) and four-point probe method at the temperature within the range of 20 K to 300 K. Generally, the curves of normalized resistance for all samples displayed normal metallic behavior above $T_{c\ onset}$. $T_{c\ zero}$ decreased from 84 to 68 K due to the charge consideration and ionic radii. The critical current density J_c was found to decrease as the concentration of Ca increased. The highest value of J_c was obtained at 3.214 A/cm^2 at x = 0.05, which is higher than that of Ca-free porous YBCO. J_c decreased monotonically with the increase of Ca concentration. The substitution of Ca at the Ba sites does not alter the orthorhombic structure of the samples. However, the volume of the unit cell increases with Ca concentration. The grains are highly compacted and randomly distributed while the grain size tends to decrease as Ca concentration is increased. Samples with the heat treatment of 900 °C for five hours showed metallic behavior beyond the onset transition temperature, $T_{c\ onset}$ and the $T_{c\ zero}$ has improved for x = 0.05, 0.30 and 0.40, otherwise vice versa at x = 0.00, 0.10 and 0.20. Further substitution of Ca has reduced the grain size with randomly distributed microstructure. The heat treatment process does not affect the crystallographic structure and remains orthorhombic. EDX results show that there is no existence of sucrose.

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